Chapter 2. Light

PAGE NO-102:

Solution 1
Refraction is the bending of light at the surface of separation, which takes when it passes from one optical medium to another optical medium with different optical densities.

Solution 2

Snell's law: The ratio of sine of the angle of incidence to the sine of angle of refraction is constant for a pair of media. This constant is called the refractive index of the second medium w.r.t the first. It is generally represented by the Greek letter (μ).

i.e. $\mu = \dfrac{\sin i}{\sin r}$

Solution 3
Yes, reflection also takes place with the refraction.

Solution 4
When a ray of light passes from one medium to another, its direction (except for normal incidence) changes because of change in speed of light. Thus, refraction occurs because light travels with different speed in different media.

Solution 5
The ray of light which is incident normally on the surface separating the two media passes undeviated. Such ray suffers no bending, thus, angle of refraction and angle of deviation is 0^{o}.

Solution 6
The phenomenon is total internal reflection

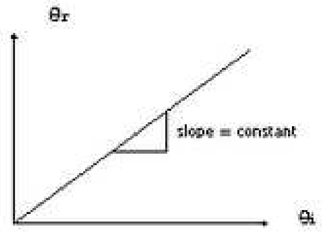
Solution 7
Refractive index being the ratio of similar quantities has no units.

Solution 8

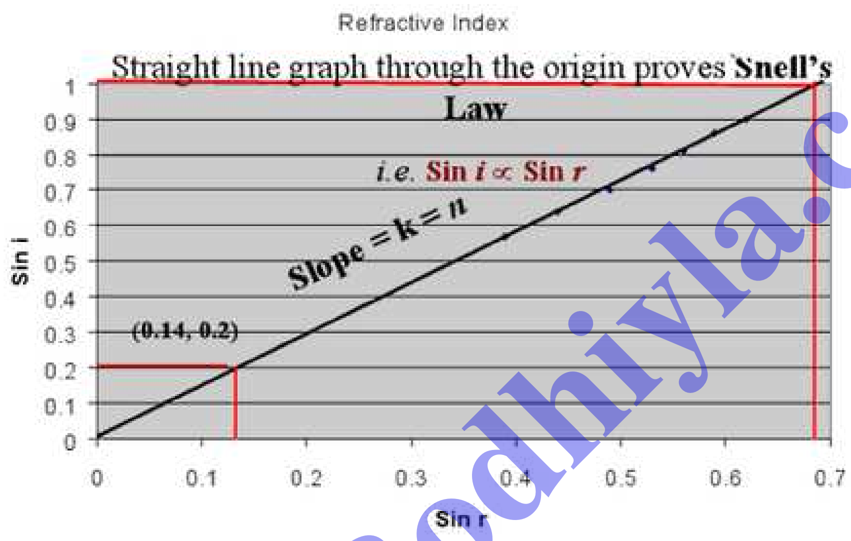
This statement means that diamond is 2.42 times optically denser than air. The velocity of light in diamond is equal to $\frac{1}{2.42}$ times velocity of light in vacuum. Thus, $v_d = \frac{3\times10^8}{2.42} = 1.24 \times 10^8$ m/s.

Solution 9

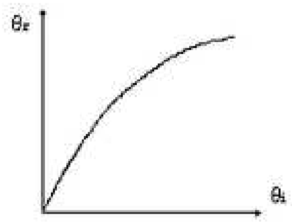
(i) Angle of incidence vs. angle of reflection graph:



(ii) Sine of angle of incidence vs. sine of angle of refraction graph:



(iii) Angle of incidence vs. angle of refraction graph:



Solution 10

$$\text{Refractive index} = \frac{\text{Speed of light in vacuum or air}}{\text{speed of light in that medium}}$$

Solution 11

Red colour of white light has least refractive index.

Solution 12

Violet colour of white light has highest refractive index.

Solution 13

According to the principle of reversibility, the path of a light ray is reversible.For e.g. if light travels from air to water along a certain path, then if the path is reversed while travelling from water to air, it will follow exactly the same path.

Solution 14

We know that,

$${}_a\mu_w = \frac{1}{{}_w\mu_a}$$

$$\therefore \; {}_w\mu_a = \frac{1}{4/3} = \frac{3}{4}$$

Solution 15

The absolute refractive index of a medium is defined as the ratio of the speed of e-m radiation in free space to the speed of radiation in that medium.

Solution 16

When light travels from one medium (air) to another medium (glass), it bends towards the normal. The extent of bending of light depends upon the speed of light (v_2) in the second medium, compared to the speed of light (v_1) in the first medium. The refractive index of the second medium w.r.t. the first medium (n_{21}) is given byn_{21} = Speed of light (v_1) in first medium / speed of light (v_2) in second mediumThe refractive index of glass is typically around 1.5, meaning that light in glass travels at c / 1.5 = 200,000 km/s. A low value of refractive index also indicates a large critical angle at the glass-air interface.

Solution 17

No, dispersion is not same as deviation.

Solution 18

Angle of deviation may be defined as the angle between original path of incident ray and the path of refracted ray.

Solution 19

The value of angle of deviation produced by a prism depends upon:

(i) The angle of incidence
(ii) The material of prism
(iii) The angle of prism
(iv) The colour of wavelength of light used.

Solution 20
(c) Diamond

Solution 21
(a) 0^o

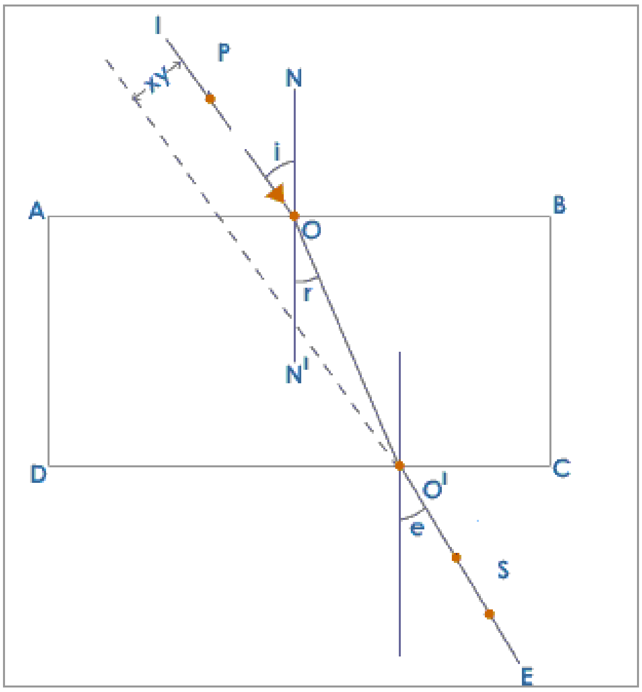
Solution 22
Ray B is the correct refracted ray because a ray of light travelling from air (rarer medium) to water (denser medium) will bend towards the normal.

Solution 23
The correct path is that of ray 'B'.

PAGE NO-103:

Solution 24

(a) Diagram showing complete path of light:



(b) Angle of incidence and angle of refraction marked in the above diagram.

$$R.I. = \frac{\sin i}{\sin r}$$

(c) Angle of emergence is marked in the above diagram.

Angle of incidence = Angle of emergence

(d) Rays IO and O'E are parallel to each other. These are incident and emergent rays respectively.

(e) In the diagram above, the lateral displacement is indicated by XY.

Solution 25

Factors affecting the critical angle are:
(i) The colour (or wavelength) of light.
(ii) The temperature (on changing the temperature of medium, its refractive index changes).

Solution 26

The critical angle for a pair of media is:(i) more than 45^{o} for red light.(ii) less than 45^{o} for blue light.

Solution 27

(a) towards the normal.
(b) away from the normal.
(c) 2/3.

Solution 28

Critical angle is the angle of incidence in the denser medium for which the angle of refraction in the rarer medium is 90o.Total internal reflection: When a ray of light travelling from an optically denser medium to an optically rare medium is incident at an angle greater than the critical angle for the pair of media in contact, the ray is totally reflected back into the denser medium. This phenomenon is referred as total internal reflection.The two necessary conditions for total internal reflection to take place are:

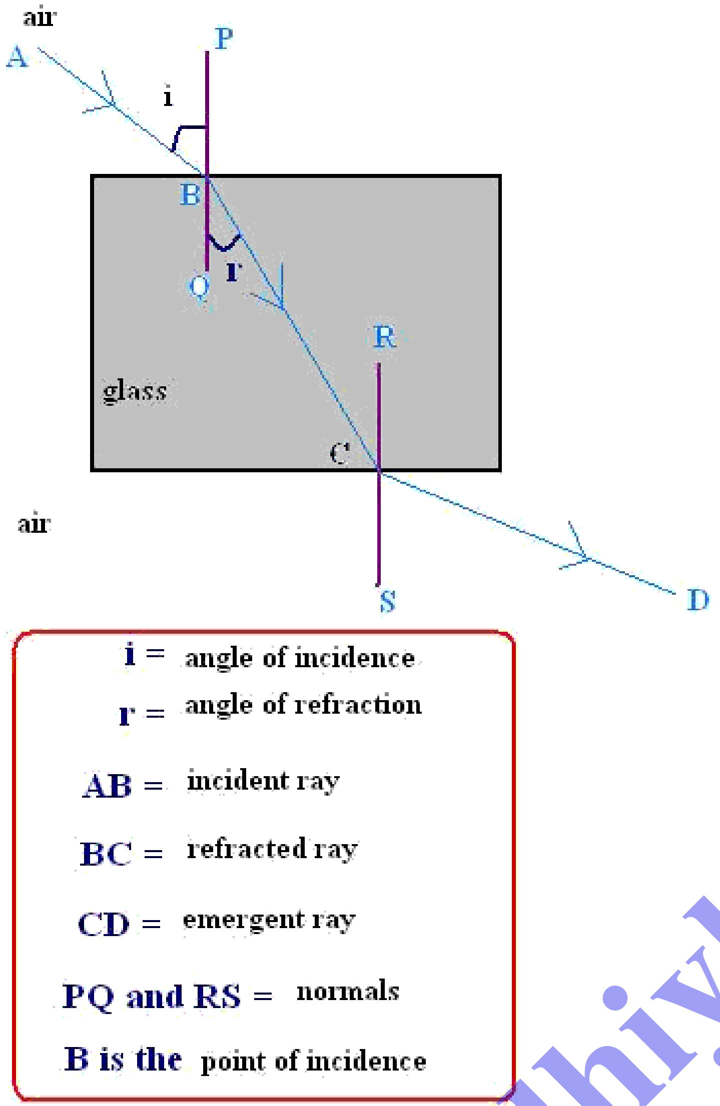
1. The light ray must proceed from denser to rarer medium.
2. Angle of incidence in denser medium should be greater than the critical angle for the pair of media in contact.Relation between critical angle and r.i.: The critical angle can thus be calculated by taking the inverse-sine ratio of speed of light in denser medium and the speed of light in rarer.

Solution 29

The critical angle for diamond is 24^{o}; this indicates that diamond has high refractive index of 2.42. This low value of critical angle facilitates total internal reflection of each light ray entering the diamond at its multiple surfaces.

Solution 30

Refraction is the bending of light at the surface of separation, which takes when it passes from one optical medium to another optical medium with different optical densities.Ray diagram showing refraction of light through a glass slab:



Solution 31

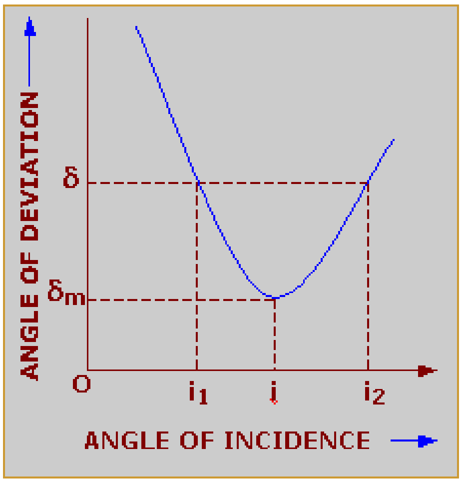
Two advantages of using total reflecting prism as a reflector in place of a plane mirror are:

(i) When total internal reflection occurs, the entire light (100%) is reflected back into the denser medium, whereas in ordinary reflection from plane mirror, some light is refracted or absorbed (i.e. reflection is partial).

(ii) Total reflecting prism gives a much brighter image than that obtained by using the plane mirror.

Solution 32

Angle of incidence Vs angle of deviation graph for a prism:



PAGE NO-115:

Solution 1

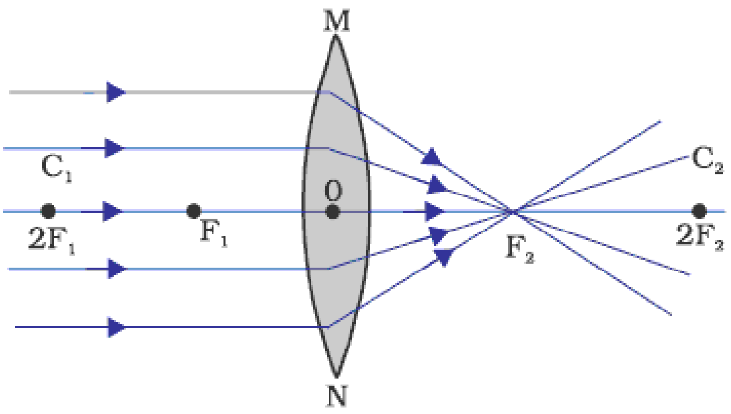
A lens may be defined as a transparent refracting medium bounded by two curved surfaces which are generally spherical.

Solution 2

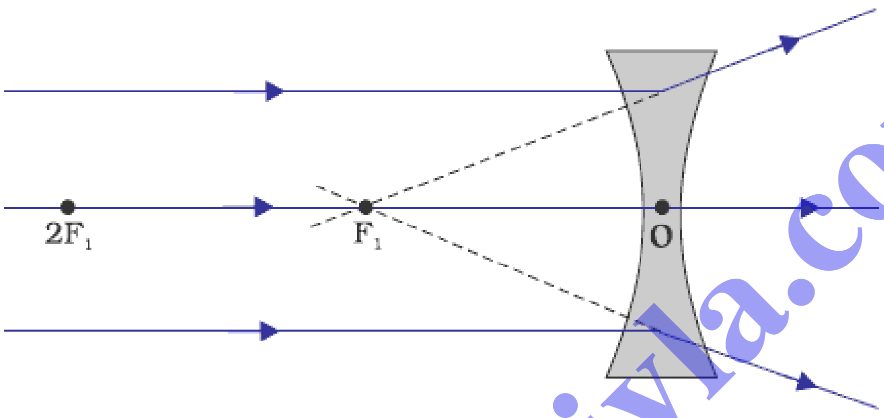
Convex lens	Concave lens
1. A convex lens is thicker in the middle and thinner at its edges. 2. A light beam converges on passing through a convex lens.	1. A concave lens is thicker at the edges and thinner in the middle. 2. A light beam diverges on passing through a concave lens.

Solution 3

(i) Diagram showing convergent action of convex lens:



(ii) Diagram showing divergent action of concave lens:



Solution 4

Focal length of a lens: Rays of light can pass through the lens in any direction and hence there will be two focal lengths on either side of the lens and they are referred to as the first focal length and the second focal length of a lens:

(i) First focal length: The distance from the optical centre of the lens to its first focal point is called the first focal length (f_1) of the lens.

(ii) Second focal length: The distance from the optical centre of the lens to its second focal point is called the second focal length (f_2) of the lens.

Solution 5

Focal length of a plane mirror is infinity.

Solution 6

The SI unit of focal length is 'metre'.

Solution 7

Principal axis of a lens is the line joining the centres of curvatures of the two surfaces of the lens.

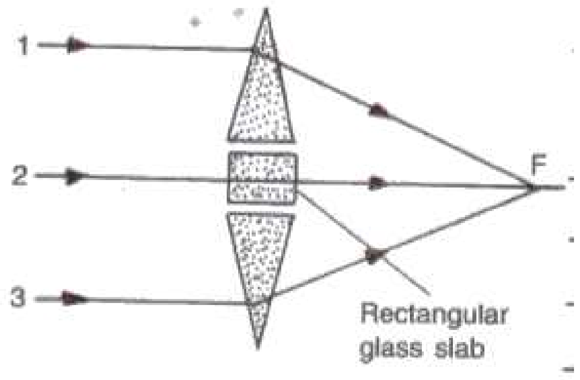
Solution 8

Focal plane of a lens: Rays of light can pass through the lens in any direction and hence there will be two focal planes on either side of the lens and they are referred to as the first focal plane and the second focal plane of a lens:

(i) First focal plane: It is the plane passing through the first focal point and normal to the principal axis of the lens.

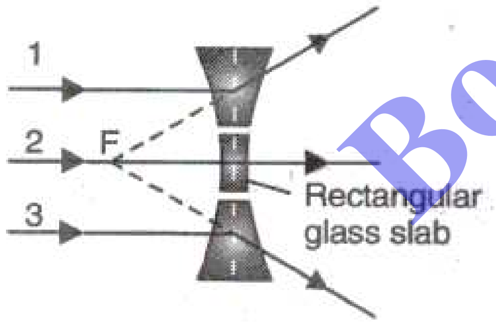
(ii) Second focal plane: It is the plane passing through the second focal point and normal to the principal axis of the lens.

Solution 9



PAGE NO-116:

Solution 10



Solution 11

(i) If the medium on both sides of the lens is same, the first and second focal lengths are equal.

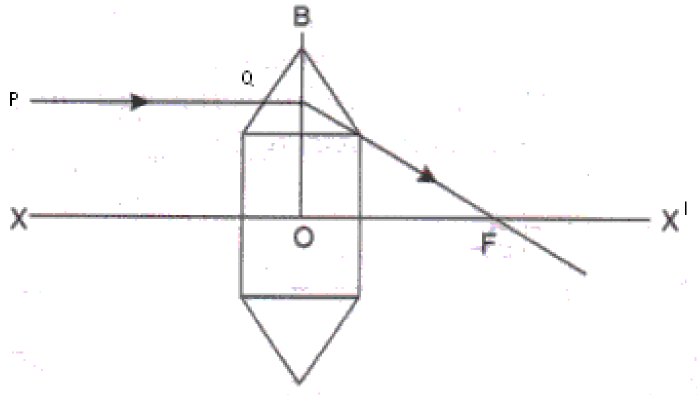
(ii) A ray of light passing through the optical centre of the lens passes undeviated.

Solution 12

(i) Convex lens.

(ii) The line XX' is called the principal axis.

(iii)



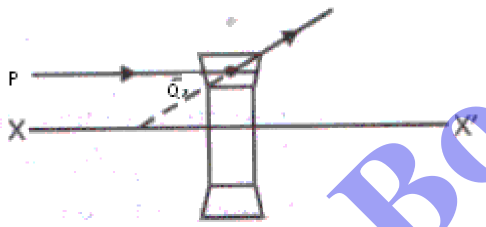
(iv) The final emergent ray will meet XX' at a point called its principal focus of the lens.

Solution 13

(i) Concave lens

(ii) The line XX' is called the principal axis.

(iii)

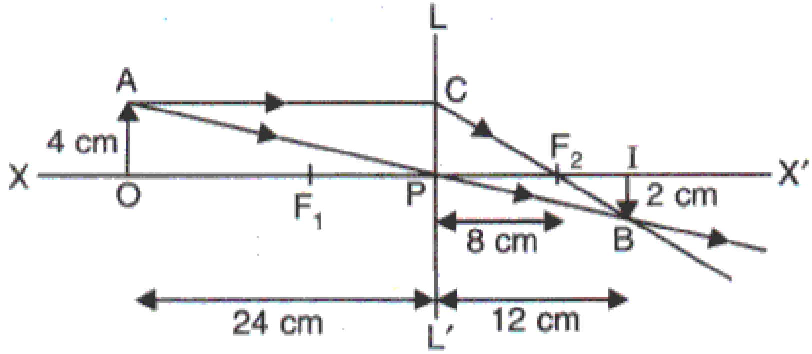


(iv) The final emergent ray will appear to meet XX' at a point called its second focus of the lens.

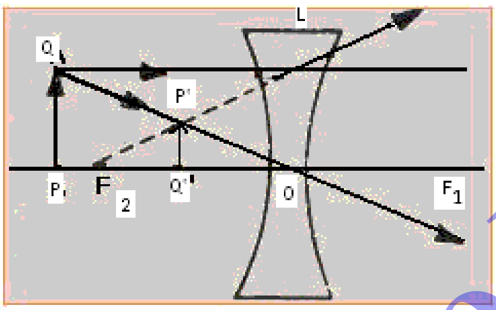
Solution 14

Choose a proper scale say, 4cm = 1 cm. Mark the lens LPL' on the principal axis XX'. In front of the lens, mark the object OA with distance OP = 24 cm and height of object OA = 4 cm.

For the object OA kept at a distance 24 cm in front of the convex lens of focal length 8 cm, the construction of the image is shown in the figure. The distance PI of image IB from the lens is 12 cm. Thus, the distance of image is 12 cm. The image is real, inverted and diminished (size 2.0 cm).



Solution 15



(i) Outline of lens is drawn in above diagram. It is a concave lens.

(ii) Shown in diagram above.

(iii) Shown in diagram above.

Solution 16

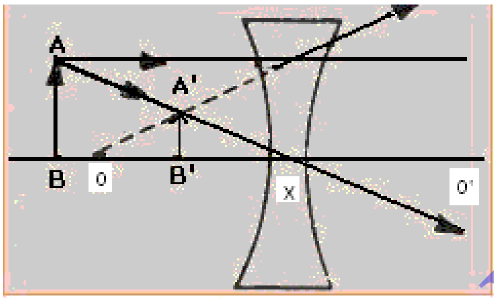
Real image	Virtual image
1. When the rays of light diverging from a point after reflection or refraction actually converge at some point, then that point is the real image of object. 2. A real image is always inverted and can be taken on the screen. 3. A real image is formed by eye, photographic camera, convex lens except when object is very close to the lens, concave mirror when the object is very close to concave mirror.	1. When the rays of light diverging from a point after reflection or refraction appear to diverge from some other point then the image is called virtual image. 2. A virtual image is always erect and cannot be taken on the screen. 3. A virtual image is formed by plane mirror, convex mirror and concave lens.

Solution 17

(i) Concave lens

(ii) Points O and O′ are second focus and first focus respectively.

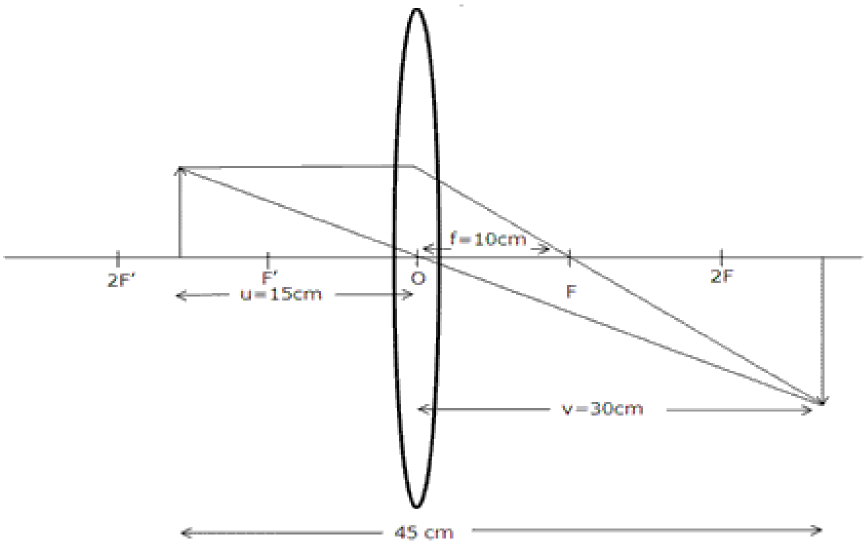
(iii)



(iv) Characteristics of image: erect, diminished and virtual.

PAGE NO-117:

Solution 18



Magnification, $m = \frac{I}{O} = \frac{u}{v} = 2$ (given)

$\Rightarrow v = 2u$

$u + v = 45cm$ (given)

$u + 2u = 45cm$

$3u = 45cm$

$\therefore u = 15cm$

Distance of lens from the object is 15cm.

$\Rightarrow v = 2u = 30cm$

We know, $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$

$= \frac{1}{15} + \frac{1}{30} = \frac{3}{30} = \frac{1}{10}$

$\Rightarrow f = 10cm$

Focal length is 10 cm.

Solution 19

(i) Power $= \frac{1}{\text{focal length (in metres)}}$

Now, a concave lens has a virtual focal length; \ f = - 50 cm.

Power $= \frac{100}{-50} = -2D$

Power of a concave lens is negative and the powe is -2D.

(ii) Focal length (in metres) $= \frac{1}{\text{Power (in Dioptres)}}$

Focal length (in metres) $= \frac{1}{2} = 0.5\ m = 50\ cm$

Since, the focal length is positive, the lens is a convex lens.

PAGE NO-123:

Solution 1

The phenomenon of splitting of white light into its constituent colours is known as dispersion.

Solution 2

(i) Ultra-violet radiation
(ii) Infra-red radiation

Solution 3

3 x 10^8 m/s is the velocity of electromagnetic radiation.

Solution 4

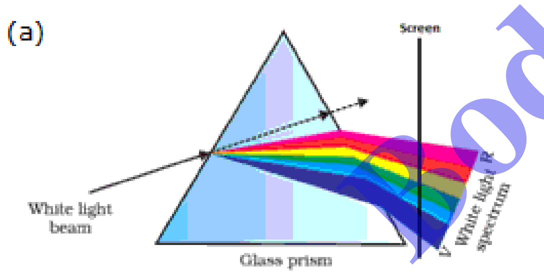
Light of different colours have different speeds in a medium.Therefore, the refractive index of glass (the material of prism) is different for different colours of light and the deviation caused by a prism is different for different colours of light.Violet is deviated the most because in glass, speed of violet is least.Red is deviated the least because in glass, speed of red is most.

Solution 5

The colour band obtained on a screen on passing white light through a prism is called the spectrum.

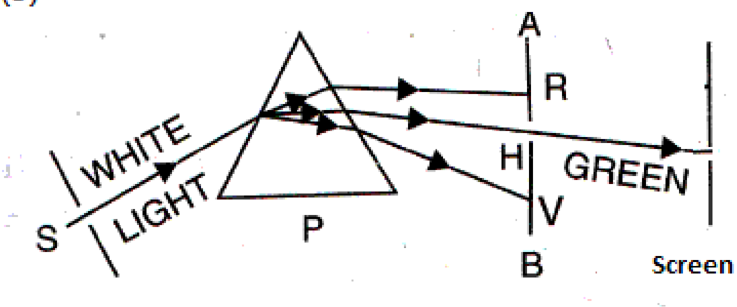
Solution 6

(a)



Dispersion of white light by the glass prism

(b)



We will observe the light of only green colour on the screen.

(c) We draw the conclusion that a prism by itself produces no colours

Solution 7

(i) It passes parallel with respect to the base of the prism.

(ii) The white light shall split into its constituent colours and a spectrum shall be formed.

Solution 8

$1 \text{ nm} = 10 \text{ Å}$

PAGE NO-124:

Solution 9

The colour band obtained on a screen on passing white light through a prism is called the spectrum.

Solution 10

If a monochromatic light passes through a prism, deviation will occur and not dispersion.

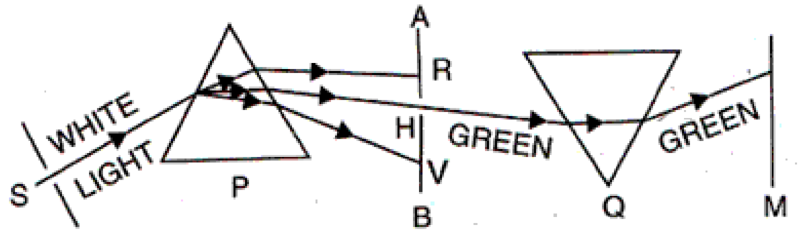
Solution 11

Dispersion occurs because light of different colour bend through different angles while passing through a glass prism.

Solution 12

A Prism itself produces no colour. This can be demonstrated by the following experiment.

Experiment: In figure below, white light from a slit S is made to pass through a prism P which forms the spectrum VR on a white screen AB. A narrow slit H is made on the screen AB parallel to the slit S to allow the light of a particular colour to pass through it. This light of a particular colour is made to fall on a second prism Q placed with its base in opposite direction to that of the prism P. The light after passing through the second prism Q is received on another white screen M.

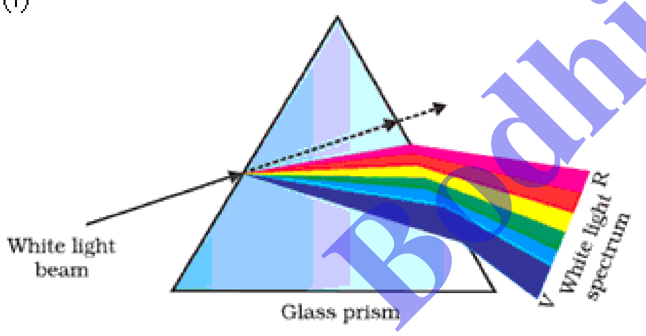


A prism by itself produces no colours

It is observed that the colour of light obtained on the screen M is same as that of the light incident on the second prism Q through the slit H. If green light is incident on the prism Q, the screen M has only green colour. This proves that the prism itself produces no colours.

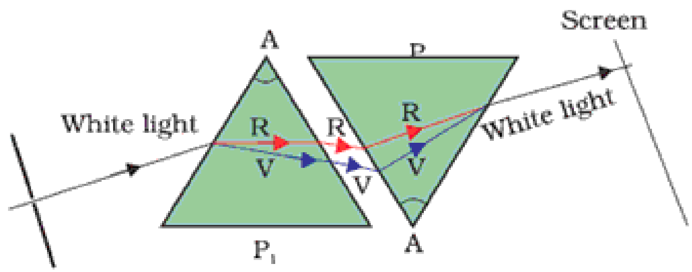
Solution 13

(i)



Dispersion of white light by the glass prism

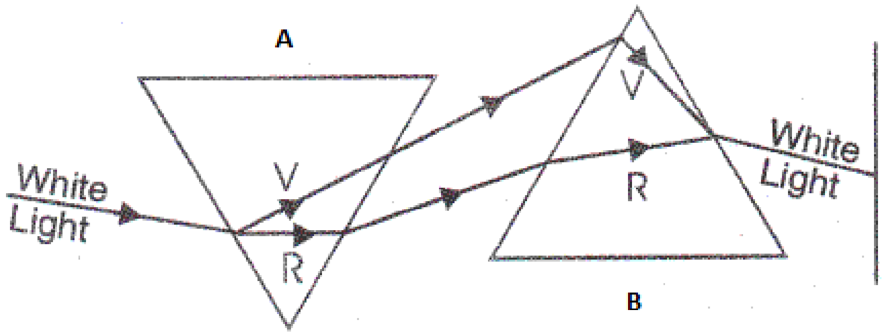
(ii)



Recombination of the spectrum of white light

Solution 14

The completed ray diagram is as shown below:



Solution 15

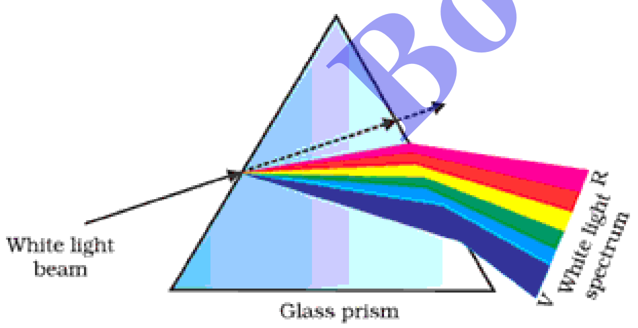
(i) Roentgen
(ii) Newton
(iii) Hertz
(iv) Marconi
(v) Hershell
(vi) Ritter

Solution 16

In vacuum both the colours have the same speed.In glass, red colour has a greater speed.

Solution 17

The colour band obtained on a screen on passing white light through a prism is called the spectrum.



Dispersion of white light by the glass prism

PAGE NO-126:

Solution 1

(a)
(v) less than one focal length

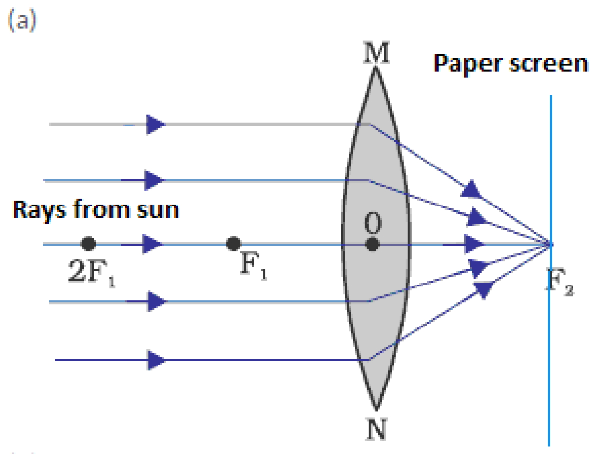
Ans1(b)
(iii) inverted and magnified.
Ans1(c)
(E) (i), (ii) and (iii)
Ans1(d)
(D) (ii) and (iii) only
Ans1(e)
(ii) real
Ans1(f)(ii)
virtual, erect, diminished
Ans1(g)
(v) Both the images are real and inverted.

PAGE NO-127:

Solution 2
(a) Principal focus: Rays of light can pass through the lens in any direction and hence there will be two principal foci on either side of the lens and they are referred to as the first principal focus and the second principal focus of a lens.First Principal Focus (F1)It is a point on the principal axis of the lens such that the rays of light starting from it (convex lens) or appearing to meet at the point (concave lens) after refraction from the two surfaces of the lens become parallel to the principal axis of the lens.Second Principal Focus (F2)It is a point on the principal axis of the lens such that the rays of light parallel to the principal axis of the lens after refraction from both the surfaces of the lens pass through this point (convex lens) or appear to be coming from this point.
(b)

Convex lens	Concave lens
1. A convex lens is thicker in the middle and thinner at its edges. 2. A light beam converges on passing through a convex lens. 3. The convex lens produces a real image that is inverted and is smaller and can be obtained on screen.	1. A concave lens is thicker at the edges and thinner in the middle. 2. A light beam diverges on passing through a concave lens. 3. A concave lens always forms a virtual image , the image is magnified and cannot be obtained on screen.

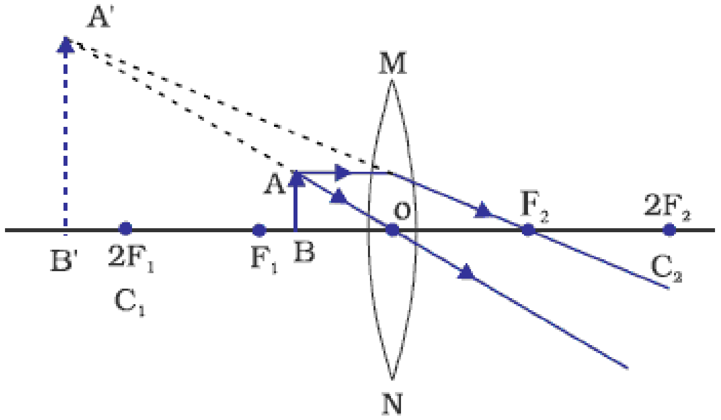
Solution 3
(a)



(b)
(i) Rays from sun can be regarded as parallel rays.
(ii) The point is called 'Focus'.
(iii) A convex lens is used to focus the sun rays on a piece of paper to burn a piece of paper. A large amount of heat gets concentrated at a point and is sufficient to burn the piece of paper.

Solution 4

(a) A convex lens with short focal length can be used as a magnifying glass.
(b) A simple magnifying glass forma a virtual, erect and magnified image of a tiny object which is distinctly seen by the eye because the eye lens converges the rays to form a real image on the retina.



Ray diagram for the formation of image by a magnifying glass.

Ray diagram for the formation of image by a magnifying glass.

Solution 5

Given O = 2 cm, u = 12 cm, f = 20 cm

I = ?, M = ?

Taking the scale of measurement are: 2 cm = 1 cm on the graph.

In the drawing,

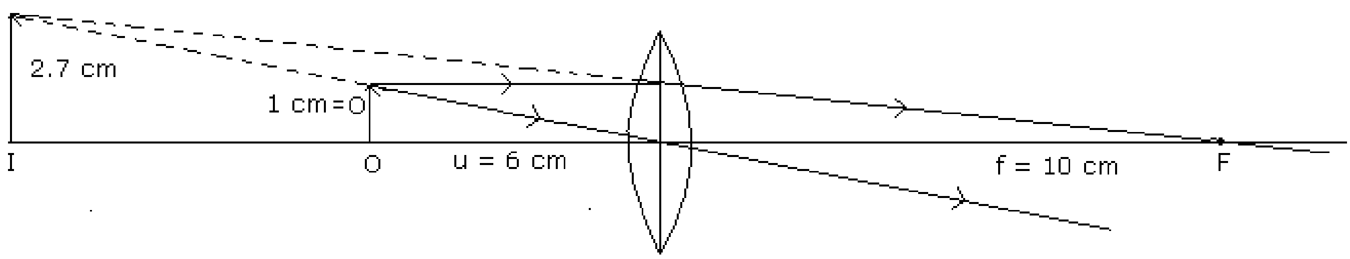
O = 1 cm, u = 6 cm, f = 10 cm

From the drawing,

I = 2.7 cm

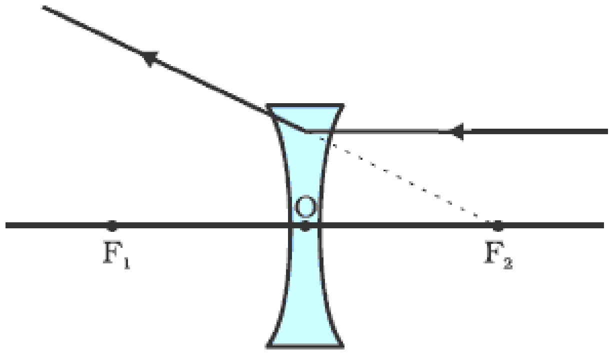
$\Rightarrow$ Actual image size $I = 2.7 \times 2 = 5.4\text{cm}$

Magnification $m = \frac{I}{O} = \frac{5.4}{2} = 2.7\,\text{cm}$



PAGE NO-128:

Solution 6



Solution 7

(a) The image of the objects at different distances from the eye is brought to focus on the retina by changing the focal length of the eye lens. This is called the power of accommodation of the eye.

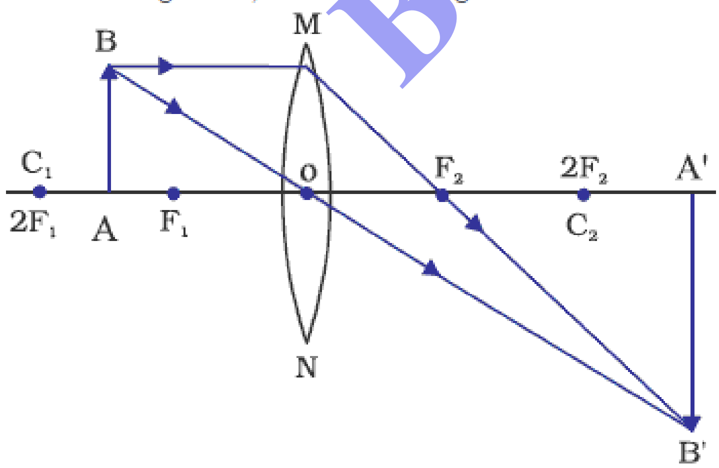
(b) Accommodation is achieved with the help of ciliary muscles. To focus the distant objects, the ciliary muscles are relaxed causing the eye lens to become thin and thus increasing the focal length of the eye lens. To form the image of a near object on the retina, the ciliary muscles contract and thereby pull the ends of the choroid closer. Thus, the eye lens thickens to shorten its focal length and converges the rays to form the image.In this manner, by changing the focal length of the eye lens, the image of the objects at different distances is brought to focus on the retina.

(c) A converging lens of suitable focal length is used in the spectacles worn by an old lady for knitting.

Solution 8

Nature of image: Real, inverted and magnified.

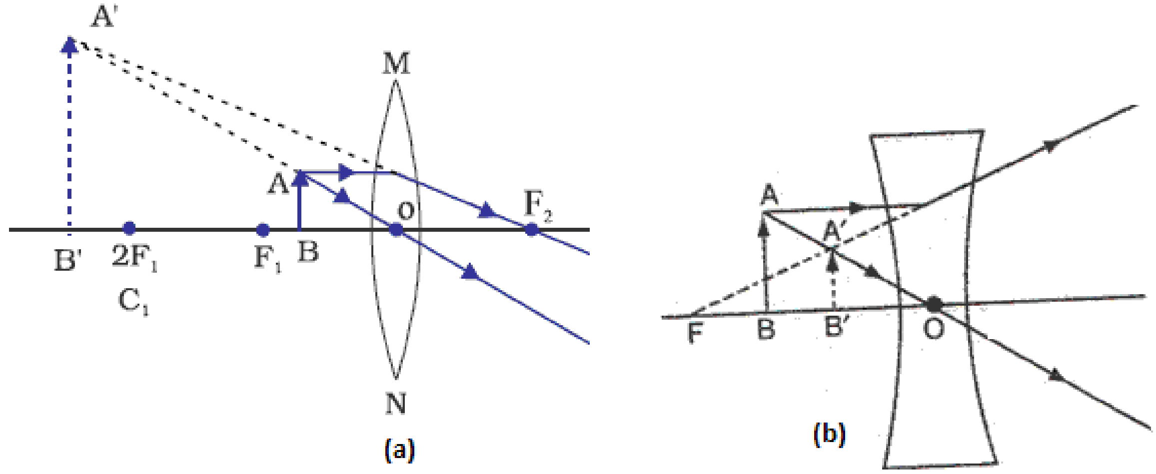
Nature of image: Real, inverted and magnified.



Solution 9

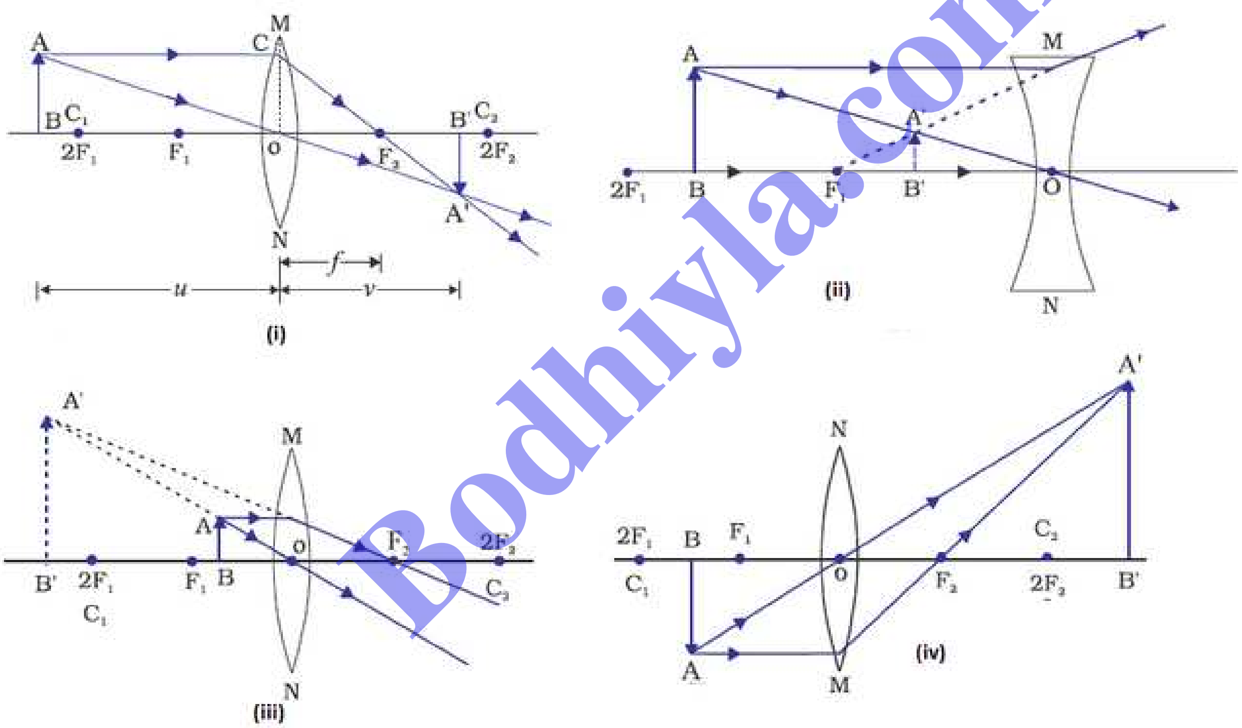
(a)

(a)



(b) In both the cases the image formed is virtual, upright and on the same side of the lens but the image formed by a convex lens is magnified and that formed by a concave lens is diminished.

Solution 10



Solution 11

(a) A, B, C and D are microwaves, infrared waves, ultraviolet light and x-rays respectively.
(b) Radiations B (microwaves) have a higher frequency.
(c) Common properties of e-m spectrum:
(i) All electromagnetic waves travel with the same speed in vacuum (or air) which is equal to the speed of light i.e. 3 x 10^8 m/s.

(ii) These waves are unaffected by the electric and magnetic fields.

(d)

Name of wave	Source
1. Gamma rays	1. Cosmic rays.
2. X-rays	2. When highly energetic electrons are stopped by a heavy metal target of high melting point (x-ray tube).
3. Ultraviolet	3. Sunlight.
4. Visible light	4. White hot bodies.
5. Infrared waves	5. Lamp with thoriated filament.
6. Microwaves	6. Electronic devices such as klystron tube.
7. Radio waves	7. Radio transmissions

(e)

Name of wave	Detector
1. Gamma rays	1. Geiger tube
2. X-rays	2. Photographic film coated with zinc sulphide
3. Ultraviolet	3. Photographic plate
4. Visible light	4. Eye photo-cells
5. Infrared waves	5. Thermopile
6. Microwaves	6. Wave guide tubes
7. Radio waves	7. Earphone

(f)

Name of wave	Use
1. Gamma rays	1. Detecting flaws in metal casting.
2. X-rays	2. Diffraction to find crystal structure.
3. Ultraviolet	3. Burglar alarms.
4. Visible light	4. Photography.
5. Infrared waves	5. Infra-red photography
6. Microwaves	6. Microwave cooking
7. Radio waves	7. Communication and navigation.

PAGE NO-129:

Solution 12

We know that,

$c = f\lambda$

Here, it is given that $c = 3 \times 10^8$ m/s

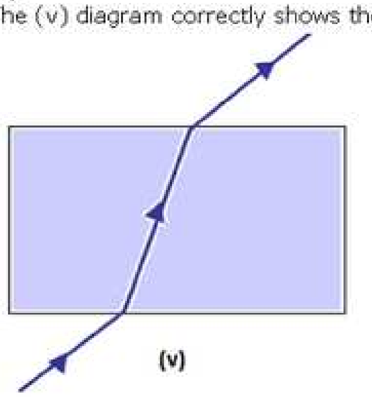
and, $\lambda_{yellow} = 6 \times 10^{-7}$ m.

$$\therefore f_{yellow} = \frac{c}{\lambda_{yellow}} = \frac{3 \times 10^8}{6 \times 10^{-7}} = 0.5 \times 10^{15} \text{Hz}$$

Solution 13

(a)

The (v) diagram correctly shows the path of the ray through the glass block



(v)

(b)

Total internal reflection takes places when:

(iii) light is going from glass to air and $\angle i > \angle C$

(c)

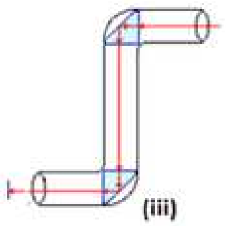
(v) $\frac{\sin w}{\sin x}$

(d)

(iv) sin i plotted against sin r

(e)

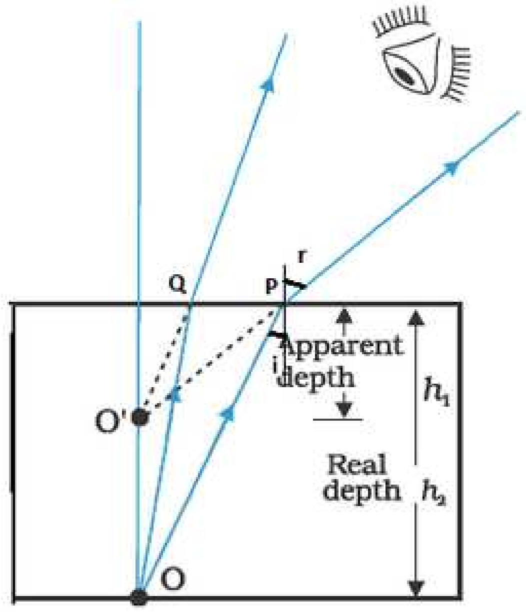
The third diagram represents the path of the light through the periscope.



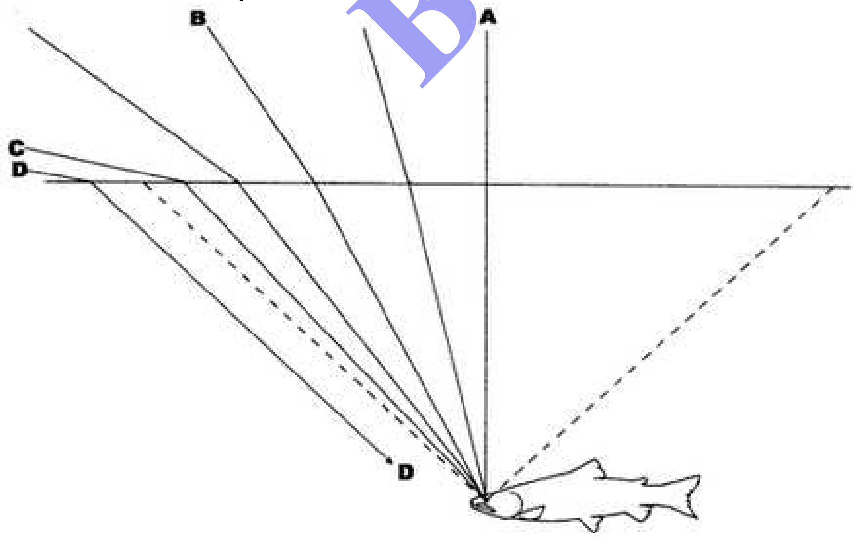
(iii)

PAGE NO-130:

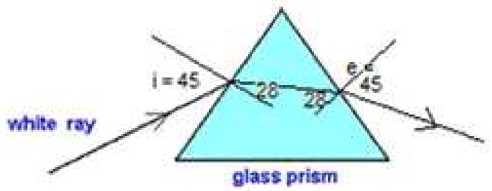
Solution 14



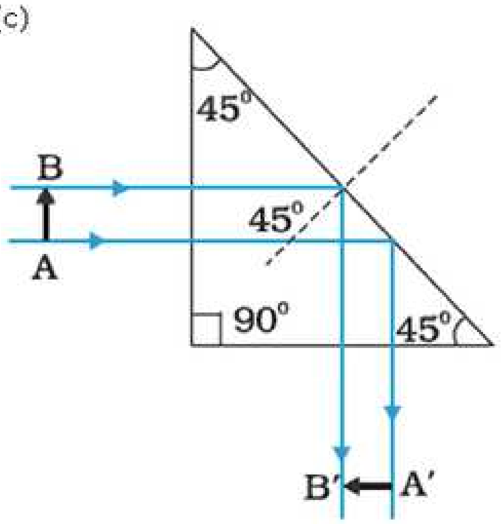
(i) Angle of incidence
(i) of ray OP is marked in the above diagram.
(ii) Angle of refraction (r) of ray OP is marked in the above diagram.
(iii) The position of image of the object (O') as seen from above is marked in the diagram.
(iv) An approximate path of ray OQ is shown in the above diagram.
(b) Water is a denser medium as compared to air; so on passing from water (denser) to air (rarer) the speed of light of light increases and it bends away from the normal. (c)Refraction is the bending of light as it passes from a medium of one optical density into a medium of a different optical density, as from air to water or water into air. The amount of bending is dependent upon the incident angle of the light. In the diagram below, a light ray, "A" strikes the water at right angles and passes through the surface without bending. But as the incident angle decreases (becomes less than 90 degrees) the light bends more and more?rays "B" and "C." Light striking the surface parallel to the surface, bends downward.Since light is coming into the water from all directions, refraction creates a cone of light with its base on the surface and its apex at the fish's eye. The base of the cone is a circular opening at the surface through which the fish sees the entire outside world. This opening is called the "Fish's Window". Only the light passing through the window enters the fish's eye. Notice line "D," It's a ray entering the water beyond the window; refraction bends it such that it cannot reach the fish's eye.



Solution 15

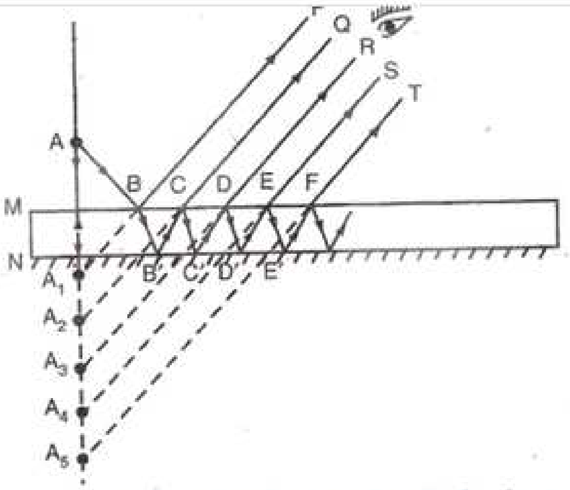


(c)



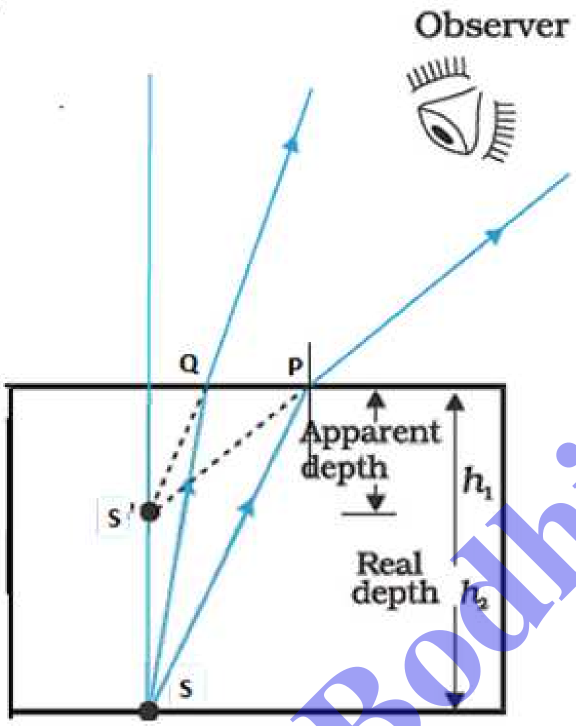
In the above diagram, light rays from the object AB are incident normally on a right angled glass prism and hence they pass undeviated. These rays fall on the other surface of the prism at 45°, which is greater than the critical angle for the glass-air interface (42°). Here, no refraction takes places but the ray of light is totally reflected back in the glass and finally it emerges out through the third surface of the prism normally forming the image A′B′ of the object AB.

(d)



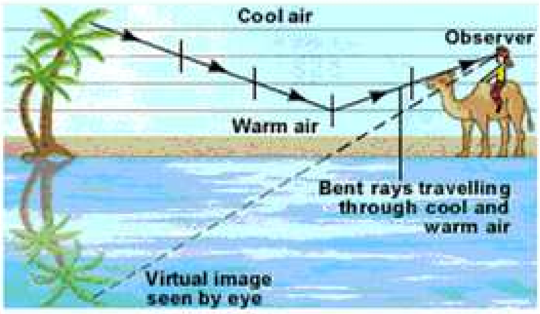
Multiple reflections in a thick mirror

(e)



(f) Mirage is a naturally occurring optical phenomenon caused due to total internal reflection light wherein an image some distant object appears displaced from its true position; ofter observed in deserts and coal-tarred roads on hot summer days.

In the desert, the air is very hot. The air near the surface of the earth is hot and is less dense. Thus, air can be considered as layers of medium with higher density in the vertical upward direction. Rays of light from an object, say, a tree bend away from the normal as they pass from the denser layer to the rarer layer. The angle of incidence increases for ea successive layer. At a certain point, when the angle of incidence becomes greater than th critical angle, the rays of light will undergo total internal reflection. The ray now starts traveling from rarer to denser medium. When the light reaches the eyes of a weary dese traveler, to him, the light will appear to emerge in a straight line in the backward directio Thus, creating an impression of water pool or oasis.



(g) $$\mu = \frac{\text{Real depth}}{\text{Apparent depth}}$$

$$\therefore \text{ Apparent depth} = \frac{\text{Real depth}}{\mu} = \frac{3}{1.3} = 2.3 \text{ m}$$

(h) Factors on which lateral displacement depends are:

1. Thickness of the glass slab
2. Angle of incidence
3. Refractive index of the glass

(i) Given the angles with the horizontal surface as:

OA making an angle of 49° with horizontal, hence i_A = 90-49 = 41

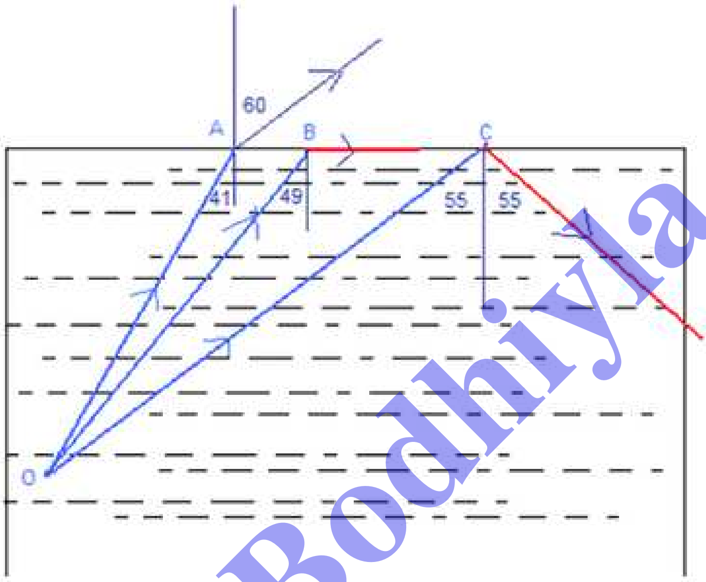
OB making an angle of 41 with horizontal, hence i_B= 90- 41 = 49

OC making an angle of 35 with horizontal, hence i_c= 90- 35 = 55

Given critical angle = 49.

So all incident angles in denser media, more than 49, will undergo total internal reflection. (Ray OC)

i = critical angle will graze through the interface (Ray OB).
i =less than critical angle will emerge out into rare medium due to refraction (Ray OA).



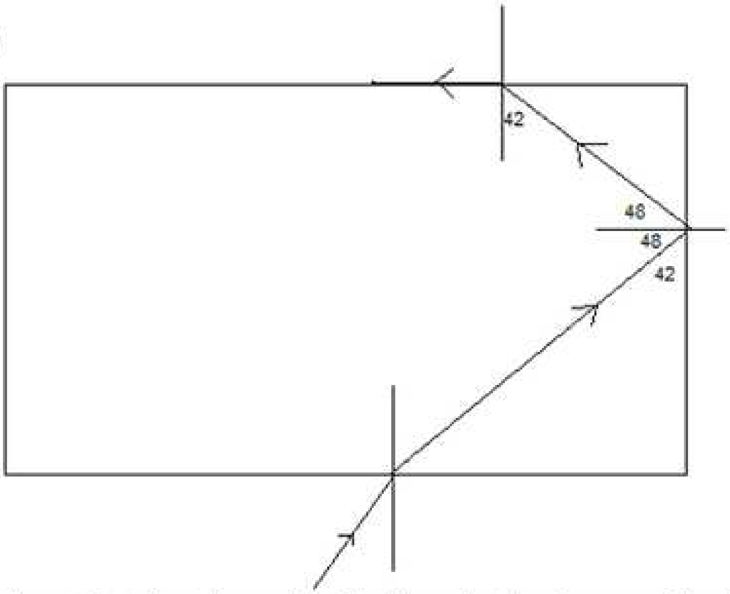
PAGE NO-131:

Solution 16

Critical angle: The angle of incidence in the denser medium for which the angle of refraction in the rarer medium is 90°.Total internal reflection: It is an optical phenomenon that occurs when a ray of light strikes the boundary of denser medium at an angle greater than the critical angle w.r.t. the normal of the surface; this ray is then totally reflected back into the denser medium.The two necessary conditions for total internal reflection to take place are:
1.The light ray must proceed from denser to rarer medium.
2. Angle of incidence in denser medium should be greater than the critical angle for the pair of media in contact.

Solution 17

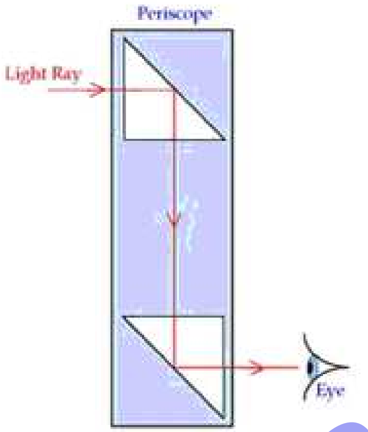
(a)



Note here that when the angle of incidence in the denser medium is more than the critical angle (= 42), then the ray undergoes total internal reflection.

At angle of incidence equal to critical angle, the ray grazes the interface.

(b) Diagram of prism periscope:



(c) In case of reflection from plane mirror, all of light is not reflected. In case of total reflecting prism, all rays falling beyond critical angle will be totally reflected. The intensity of reflected light is equal to the intensity of incident light in case of total internal reflection but not in case of reflection from plane mirror.

In addition, the reflection through a thick mirror causes multiple image formation as well as lateral inversion of image.

Due to the above two reasons, the total reflecting prisms are preferred over the plane mirrors.

Solution 18

(a) Dispersion

(b) Red colour at X and violet colour at Y.

(c) Above X, we would detect infra-red radiation and below Y, ultra-violet radiation.

PAGE NO-132:

Solution 19

Two properties of ultraviolet radiation different from the visible light:1. Ultraviolet radiation can pass through quartz, but they are absorbed by glass.2. They are usually scattered by the dust particles present in the atmosphere.

Solution 20

Three properties of infrared radiations similar to the visible light:

1. They travel in straight lines as light does, with a speed equal to 3×10^8 m/s in vacuum.
2. They obey laws of reflection and refraction.
3. They are unaffected by electric and magnetic fields.

Two properties of infrared radiation different from the visible light:

1. They are absorbed by glass, but they are not absorbed by rock-salt.
2. They are detected by their heating property using a thermopile or a blackened bulb thermometer.

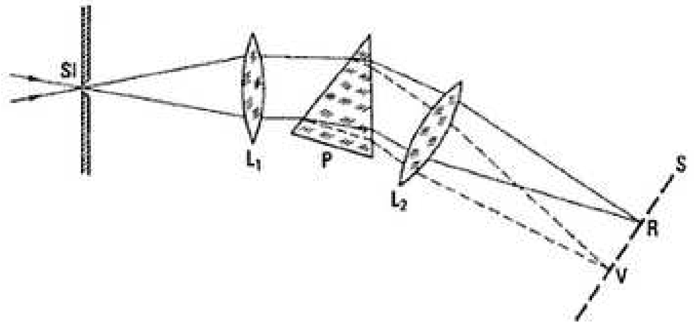
Solution 21

Waves A are Gamma radiations.Waves B are infrared radiations.In vacuum, both travel with the same speed. Hence, the ratio of their speeds is 1:1.

PAGE NO-133:

Solution 24

(a)



(b)

A pure spectrum is that spectrum in which the different colours are distinctly seen without any overlapping. Following conditions must be satisfied to get a pure spectrum.

(1) The slit (placed in front of the source) must be as narrow as possible. A wide slit is equivalent to a large number of narrow slits placed side by side. Each narrow slit will give its own spectrum. So, there will be overlapping of different spectra.

(2) The rays of light in the incident beam must be parallel to each other. This is achieved by using a convex lens. A convex lens should be so placed that the slit is at its focus. The convex lens used in this way is called collimating lens while the beam emerging out of this lens is called collimated beam.

If the incident beam is parallel, then in the refracted beam, all the rays of the same colour will be parallel and will be focussed separately.

(3) The prism must be placed in the minimum deviation position. When the prism is placed in the position of minimum deviation, all the rays are deviated by equal amounts. This ensures freedom from overlapping.

(4) On emergence from the prism, all rays of one colour should form a parallel beam of their own. If a convex lens is suitably placed in the path of these rays, then each parallel beam will come to its own focus. In this way, a pure spectrum will be obtained.

Solution 25

The electromagnetic radiations of wavelength from 100 Å to 4000 Å are called the ultraviolet radiations.

Detection: If the different radiations from the red part of the spectrum to the violet end and beyond it are made incident on the silver-chloride solution, it is observed that from the red end to the violet end, the solution remains almost unaffected. However just beyond the violet end, it first turns violet and finally it becomes dark brown (or black). Thus, there exist certain radiations beyond the violet end of the spectrum, which are chemically more active than the visible light. These radiations are called the ultraviolet radiations.

Two properties of ultraviolet radiation:

1. Ultraviolet radiation can pass through quartz, but they are absorbed by glass.

2. They are usually scattered by the dust particles present in the atmosphere.

One use of ultraviolet radiation:

In producing, vitamin D, in food of plants and animals.

Solution 26

Three properties of ultraviolet radiations similar to the visible light:

1. They travel in straight lines as light does, with a speed equal to 3 x 108 m/s in vacuum.

2. They obey laws of reflection and refraction.
3. They are unaffected by electric and magnetic fields.

Solution 27

We know that,

$v = f\lambda$

Here, it is given that $c = 3 \times 10^8$ m/s

and, $f = 500$ MHz $= 500 \times 10^6$ Hz

$\lambda = 60$ cm $= 0.6$m.

$\therefore v = (500 \times 10^6) \times (0.6) = 3 \times 10^8$ m/s;

which is same the velocity of the e-m wave in vacuum or air.

The medium through which it is travelling is either air or vacuum.